

Application/Control Number: 10/688,678

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1. (Original) A semiconductor die, comprising:
an integrated circuit supported by a substrate and having a plurality of integrated circuit devices, wherein at least one of the plurality of integrated circuit devices comprises a capacitor, the capacitor comprising:
a bottom electrode;
a first metal oxynitride barrier layer overlying the bottom electrode;
a metal oxide dielectric layer overlying the first metal oxynitride barrier layer;
a second metal oxynitride barrier layer overlying the metal oxide dielectric layer;
and
a top electrode overlying the second metal oxynitride barrier layer.
2. (Currently Amended) The semiconductor die of claim 1, wherein each of the first and second metal oxynitride barrier ~~[[layer]] layers~~ individually comprises a metal oxynitride having a composition of the form MOxNy , wherein M is a metal component selected from the group consisting of chromium, cobalt, hafnium, iridium, molybdenum, niobium, osmium, rhodium, ruthenium, tantalum, titanium, tungsten, vanadium and zirconium.
3. (Original) The semiconductor die of claim 2, wherein the metal component of the first metal oxynitride barrier layer is the same as the metal component of the second metal oxynitride barrier layer.
4. (Original) The semiconductor die of claim 2, wherein x ranges from approximately 0.05 to approximately one-half the maximum valence value of the metal component M minus 0.05 and y ranges from approximately 0.1 to approximately the maximum valence value of the metal component M minus 0.1.
5. (Original) The semiconductor die of claim 2, wherein M is a metal component selected from the group consisting of chromium, hafnium, molybdenum and tungsten, and wherein x

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ranges from approximately 0.05 to approximately 2.95 and y ranges from approximately 0.1 to approximately 5.9.

6. (Currently Amended) The semiconductor die of claim 1, wherein each of the first and second metal oxynitride barrier ~~[[layer]] layers~~ individually comprises a tungsten oxynitride having a composition of the form WO_xNy , wherein x ranges from approximately 0.05 to approximately 2.95 and y ranges from approximately 0.1 to approximately 5.9.

7. (Currently Amended) The semiconductor die of claim 1, wherein at least one electrode of the bottom and top electrodes comprises a metal nitride.

8. (Currently Amended) The semiconductor die of claim 1, wherein at least one electrode of the bottom and top electrodes comprises tungsten nitride.

9. (Original) The semiconductor die of claim 1, wherein the bottom electrode comprises a metal nitride having a metal component the same as the metal component of the first metal oxynitride barrier layer.

10. (Original) A semiconductor die, comprising:
an integrated circuit supported by a substrate and having a plurality of integrated circuit devices, wherein at least one of the plurality of integrated circuit devices comprises a capacitor, the capacitor comprising:

- a bottom metal nitride electrode;
- a first metal oxynitride barrier layer overlying the bottom metal nitride electrode;
- a metal oxide dielectric layer overlying the first metal oxynitride barrier layer;
- a second metal oxynitride barrier layer overlying the dielectric layer; and
- a top metal nitride electrode overlying the second metal oxynitride barrier layer.

11. (Original) The semiconductor die of claim 10, wherein the metal oxide layer comprises tantalum oxide.

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12. (Original) The semiconductor die of claim 10, wherein the bottom and top electrodes comprise tungsten nitride.

13. (Currently Amended) A semiconductor die, comprising:

an integrated circuit supported by a substrate and having a plurality of integrated circuit devices, wherein at least one of the plurality of integrated circuit devices comprises a capacitor, the capacitor comprising:

a bottom electrode having a bottom electrode metal component;

a top electrode having a top electrode metal component;

a dielectric layer interposed between the bottom electrode and the top electrode;

an oxynitride barrier layer having a barrier metal component, wherein the barrier metal component is different from the bottom electrode metal component ~~or wherein the barrier metal component is different from the top electrode metal component, and~~ wherein the oxynitride barrier layer is interposed between the dielectric layer and the bottom electrode ~~or wherein the metal oxynitride barrier layer is interposed between the dielectric layer and the top electrode; and~~

a second barrier layer, ~~wherein the second barrier layer is interposed between the dielectric layer and the bottom electrode or wherein the second layer is interposed between the dielectric layer and the top electrode.~~

14. (Currently Amended) The semiconductor die of claim 13, wherein the ~~[[metal]]~~ oxynitride barrier layer comprises MO_xN_y , wherein M is a metal selected from the group consisting of: chromium, cobalt, hafnium, iridium, molybdenum, niobium, osmium, rhenium, rhodium, ruthenium, tantalum, titanium, tungsten, vanadium and zirconium.

15. (Original) The semiconductor die of claim 14, wherein x ranges from approximately 0.05 to approximately one-half the maximum valence value of the metal M minus 0.05 and y ranges from approximately 0.1 to approximately the maximum valence value of the metal M minus 0.1.

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16. (Original) The semiconductor die of claim 14, wherein M is a metal selected from the group consisting of chromium, hafnium, molybdenum and tungsten, and wherein x ranges from approximately 0.05 to approximately 2.95 and y ranges from approximately 0.1 to approximately 5.9.

17. (Currently Amended) The semiconductor die of claim 13, wherein the [[metal]] oxynitride barrier layer comprises a tungsten oxynitride having a composition of the form WO_xNy , wherein x ranges from approximately 0.05 to approximately 2.95 and y ranges from approximately 0.1 to approximately 5.9.

18. (Original) The semiconductor die of claim 13, wherein at least one of the top and bottom electrodes comprises a metal nitride.

19. (Currently Amended) A semiconductor die comprising:
an integrated circuit supported by a substrate and having a plurality of integrated circuit devices, wherein at least one of the plurality of integrated circuit devices comprises a capacitor, the capacitor comprising:

a bottom electrode having a bottom electrode metal component;

a top electrode having a top electrode metal component;

a dielectric layer interposed between the bottom electrode and the top

electrode;

an oxynitride barrier layer having a barrier metal component, wherein the barrier metal component is different from the bottom electrode metal component, and wherein the oxynitride barrier layer is interposed between the dielectric layer and the bottom electrode;
and

a second barrier layer interposed between the dielectric layer and the top electrode. The semiconductor die of claim 13, wherein at least one of the top and bottom electrodes comprises tungsten nitride.

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20. (Original) The semiconductor die of claim 13, wherein the dielectric layer comprises a metal oxide dielectric material selected from the group consisting of $\text{Ba}_2\text{Sn}(1-z)\text{TiO}_3$, (where $0 < z < 1$), BaTiO_3 , SrTiO_3 , PbTiO_3 , $\text{Pb}(\text{Zr,Ti})\text{O}_3$, $(\text{Pb,Lu})(\text{Zr,Ti})\text{O}_3$, $(\text{Pb,Lu})\text{TiO}_3$, Ta_2O_5 , KNO_3 , Al_2O_3 and LiNbO_3 .

21. (Original) The semiconductor die of claim 13, wherein the dielectric layer comprises tantalum oxide.

22. (Currently Amended) A semiconductor die, comprising:

an integrated circuit supported by a substrate and having a plurality of integrated circuit devices, wherein at least one of the plurality of integrated circuit devices comprises a capacitor, the capacitor comprising:

a bottom electrode having a bottom electrode metal component;

a top electrode having a top electrode metal component;

a dielectric layer interposed between the bottom electrode and the top electrode;

a tungsten oxynitride barrier layer having a barrier metal component, wherein the barrier metal component is different from the bottom electrode metal component or wherein the barrier metal component is different from the top electrode metal component, wherein the tungsten oxynitride barrier layer is interposed between the dielectric layer and the bottom electrode or wherein the tungsten oxynitride barrier layer is interposed between the dielectric layer and the top electrode; and

a second barrier layer, wherein the second barrier layer is interposed between the dielectric layer and the bottom electrode or wherein the second layer is interposed between the dielectric layer and the top electrode.

23. (Original) The semiconductor die of claim 22, wherein the tungsten oxynitride barrier layer has a composition of the form WO_xN_y , wherein x ranges from approximately 0.05 to approximately 2.95 and y ranges from approximately 0.1 to approximately 5.9.

24. (Original) The semiconductor die of claim 22, wherein at least one of the top and bottom electrodes comprises a metal nitride.